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The Natural Role of Fire

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The Natural Role of Fire

Fire is a significant force in the forest environment. Depending upon specific land management objectives, plus a host of environmental variables, fire will sometimes be an enemy, at times a friend, and frequently its effects will be mixed between the two extremes.

To extend knowledge of fire's role in Florida forests, this publication has been developed from scientific literature review and observations by experienced personnel. To be most useful, the general principles that follow must be localized to specific environments or management units. In that way, indepth knowledge of fire can be used to enhance productivity of the earth's ecosystems in all their infinite variety.

One great truth of this environmental age is that it is far better to complement natural systems than to manipulate them for single-purpose gain. It is through recognition of ecological interrelationships that we can best manage natural resources for the public good. Ignorance of ecological interrelationships is no excuse for land management errors.

To meet future environmental demands, land managers must build uncommon strength in all three fire activities: prevention, protection, and fire prescribed for ecological benefits. Fire management, in full partnership with other environmental factors, is necessary for quality land management.

The Two Faces of Fire

The Monster

Uncontrolled wildfire raging through a forest can have disastrous effects. Healthy trees are reduced to blackened snags; shrubs that provided food and cover for wildlife become ashes; under the intense heat some soil nutrients are vaporized and become airborne in clouds of choking smoke. Ash falls on rooftops, windowsills, and darkens clothes drying outdoors in nearby towns. Where people once enjoyed a green, scenic landscape, they see a stark, gray landscape. A forest has been grossly changed; the web of life it encompassed and nurtured has been broken. Here, fire has shown its mastery over the land and has behaved as a monster.

Or has it?

The Friend

Think about fire for a moment. If you have warmed your hands in its welcomed heat and enjoyed its friendly light, you know that all fire is not the raging holocaust. Fire, along with air, water, and earth, is a basic environmental factor. We do not judge air as "bad" because of periodic, destructive hurricanes. We are drawn to water rather than avoiding it despite its potential to cause devastating floods. We do not fear the earth though we know that forces beyond our

control can cause it to quake and slide. Fire, no less than air and water, has been a natural directing force in human evolution and the earth we inhabit. History indicates that humans learned to use and control fire. Fire was, perhaps, our first tool. Yet today the acceptance of fire in the forest seems basically contrary to our beliefs in "modern" times. Perhaps we feel we have progressed beyond the need for direct dependence on this natural force. Or maybe we simply do not know and understand it any longer.

Lightning . . .

In The Making

"Continued sunny and warm except for isolated afternoon or evening thunderstorms. Thirty percent chance of rain." This is a familiar midsummer weather forecast in Florida.

From over the Atlantic Ocean and the Gulf of Mexico, air masses directly affect Florida's weather. Warm air is lifted high into cool, upper air layers. The cooling of this rising air causes its moisture to condense and clouds to form. Moisture droplets form in the upper, cold parts of the clouds. When they reach a certain size, the droplets begin to fall earthward, away from the influence of the cold air back into warm, uplifting currents. The droplets may again vaporize and be lifted even higher into the upper air layers. A repeated cycle of warming, lifting, and cooling causes the buildup of tall columns of billowy clouds. The bases of the clouds may be 3,000 feet above sea level—the tops of the cloud columns develop upward to levels of 60,000 feet.

The Ignition Source

Inside the clouds electrical charges build up and separate into positive and negative centers. The upper portion of the cloud becomes positively charged and the lower portion becomes negatively charged. The negative charge near the cloud base induces a positive charge on the ground—a reversal of the fair weather pattern when the ground charge is negative. Potential gradients between positive and

negative centers, with some assistance from friction caused by falling water droplets, lead to those large sparks known as lightning discharges. Cloud-to-ground lightning is usually a discharge between the negative lower portion of the cloud and the positive charge on the ground.

Most thunderstorms in Florida are accompanied by rain. Lightning fires occur when the lightning bolt strikes outside the area of rainfall or it ignites dry fuels that smolder through the rain shower and begin to burn as the area dries out following the shower.

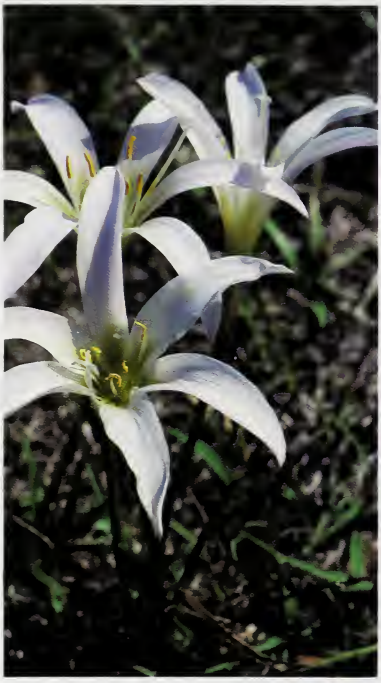
Forests . . .

Energy to Use — Or Burn

From a distance, pines and other vegetation look fresh and green. Close inspection reveals that the greenness is a shell enveloping a core of dry needles, twigs, and branches. In the needled or leafy part of a tree, known as the crown, growth occurs at the branch tips, so the youngest, greenest parts are always around the outside edges. Here, photosynthesis occurs.

Photosynthesis is the major function of every green plant. It is the process by which light energy from the sun is converted to a form of energy that can be stored and used by the plant. Generally, the conversion is to chemical energy and involves the formation of a series of complex organic compounds. Some of the compounds impart the "piney" odors we enjoy in forests. What we cannot tell from their pleasant aroma is that these compounds are very flammable.

Once stored, the energy can be used in different ways. For example, it can be used by the plant to produce wood or grow more needles in which more energy conversion will take place. It can be



used as a source of food by animals that browse the leaves and twigs where the compounds are stored. The energy can also be used to produce seed to germinate and produce another plant. This energy-storing process takes place with shrubs and grasses as well as trees; photosynthesis and the energy conversions and transfers that occur are complex, but the result is clear enough: *during one growing season in one acre of forest, enough sun energy is converted and stored in plant material to equal the energy reservoir in 300 gallons of gasoline.*

The Fuel Supply

In the shaded, lower portion of the crown, less photosynthesis occurs, but forest fuels build up by a different means. Pine needles and branches die and fall from the lower limbs. The more crowded trees are in a forest, the faster this natural dieback and pruning occurs. When sunlight reaches the forest floor, shrubs and grasses grow beneath the trees in an understory. As these shrubs lose their leaves each year, they add to the accumulation of dead organic matter.

With a natural ignition source like lightning and a fuel supply so readily available and increasing, why aren't the forest areas a big ash heap? Why are there still thriving forests in Florida? The answers to these questions lie in understanding the long-term relationship between fire and forests in this area.

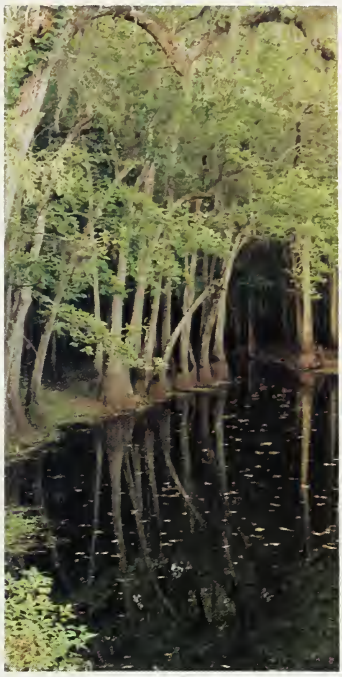
Fire And The Forest

We often regard fire as an agent of destruction, but to Nature, it is an agent of necessary change. Fire changes one form of energy to another. Green plants change light energy to chemical energy; fire changes chemical energy to heat energy.

Fire breaks down complex organic molecules to smaller ones—the same thing that occurs when we digest food. The protein in a piece of meat cannot be used directly by the human body to build cells and tissues. We must eat the meat before large protein molecules can be broken down to smaller amino acid molecules, recycled through our bodies, and rebuilt into human tissue. When a fire changes a log to ash, nutrients bound in chemical compounds are released and changed to a form that is more water soluble. In this soluble form, nutrients percolating into the soil are again usable in the growth of other plants.

Fire also effects a more visible change. Ash and nutrients occupy less space than trees and shrubs. By creating openings in forests, fire changes space relationships. Species that remain in these openings may be fire tolerant. Other species that can not withstand fire are eliminated. Thus, fire changes both the composition and the density of the forest. This change will remain for several years and affect the fuels available during the next burning cycle.

Scientists who study plant and animal relationships tell us that forests in this part of the country owe their existence and continued presence to a long history of periodic fires. This association of some tree and shrub species with fire is an example of adaptation.



Forests in Florida have existed here for at least 12,000 years. During that time, thousands of fires occurred annually. Plant species that survived these fires did so because of special features or characteristics they possessed. Plant species lacking these features were eliminated from frequently burned areas; their distribution has been confined to areas where fires are less likely to occur: moist areas such as bays, swamps, and creek bottoms.

Fires, like many natural events, are somewhat cyclic. The cycle is governed by conditions such as general climate, topography, soil type, existing vegetation, and other factors. Accordingly, the repeatability of the cycle varies. Before 1900, fire-susceptible areas probably had fires every 3 to 10 years. In areas less likely to burn, the cycle may repeat every 10 to 100 years. Cyclic, recurrent fires of the past 12,000 years were important agents of selection in determining plant species and distribution in Florida.

Trees Born Of Fire

Special adaptive features have allowed some plants to survive naturally occurring fire. Adult southern pines have a thick bark that insulates the inner, living tissues from fire's heat. Longleaf pine is so fire resistant that some trees almost always escape fire's injurious effects. These trees become seed trees for the reforestation of a burned area. Sand pine exhibits yet another adaptation for coping with fire. Sand pine cones remain closed until a fire's intense heat opens the cone and allows the seeds to fall out.

Seeds of cone-bearing trees that persist in fire-susceptible areas sprout and grow best under conditions created by fire: soil free from litter, an increased nutrient reserve, plus open areas with plenty of sunlight. In contrast, species less adapted to fire, such as oaks, gums, cypress, and cedar, do not usually reseed a burned area directly. Seedlings of these species prefer partial shade and plenty of moisture. Generally, they will reestablish only after some other type vegetation is present.

The Changing

Natural fires kept Florida's forests dynamic, diverse, and beautiful. Florida was named by the early explorers because of the abundance of wildflowers in areas kept open by frequent fires. Historically, timber stands were replaced by young trees; sometimes one type of forest was replaced by another. Changes in tree cover occur together with even more encompassing changes—because a forest is more than just trees. A forest displays interdependence, interrelationships, and competition among trees, shrubs, flowers, grasses, big and little animals, soils, microbes, minerals and nutrients in soils, and the air pervading and surrounding all of these. A forest is a complex life system. Each part has a place and a function in its organization—an organization called the forest ecosystem. Because all parts of the system are interrelated, no one part can change without a widespread effect throughout the entire system.

Forest fires affect more than trees. Fire-caused changes in ecosystems result in both stress and relief to plant and animal life—both to individuals and to whole plant and animal communities. Thousands of years of natural fires achieved a dynamic balance between the stresses and reliefs. The fire-adapted pine forests thrived over vast areas. They provided habitat for hundreds of species of grasses and wildflowers and dozens of animal species. All these species would quickly begin to decline in number and health and eventually disappear completely if fire is excluded.

Fire's Role in the Ecosystem

A Balancing Act

Scientists have studied forests and fires to determine the secret of Nature's success in attaining this necessary balance. They have learned that a "natural" fire results from a certain fuel condition. Some forest types produce and accumulate fuels faster than others; some decompose fuels more readily than others. However, at some point in time, every forest type has fuel of the right quantity and quality for that forest to be "ready" to burn.

In the past, forest fires would benefit the whole forest ecosystem because their frequency and intensity was determined by the system's natural readiness to burn. When there is a departure from the natural fire cycle and fuels accumulate beyond the natural fire point, the ultimate, inevitable fire will be more severe. Fed by extraordinary amounts of fuel, a fire's intensity may increase beyond the beneficial point for some parts of the ecosystem. Soils can be overheated and root systems damaged. Living tree crowns, as well as dead needles and branches, may be reduced to ashes.

The Dilemma

Scientists are studying things other than forests and fires—things like population increases, wildlife needs, recreation needs and demands, increased hunting pressures, and a diminishing natural-resource base.

Obviously, all forest fires cannot be permitted to burn uncontrolled according to the whimsical dictates of lightning strikes or the carelessness of humans. Yet, in attempting to protect these forest values, the powerful role of fire has almost disappeared from the ecosystem it once shaped and created. The inevitable release of natural energy is only postponed—the probability of a devastating wildfire is increased. How, then, can the powerful force of fire be used in a way that cooperates, not conflicts, with nature?

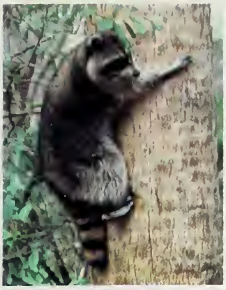
No Simple Solution

Periodic natural fires prevent the heavy buildup of fuel which, when ignited, can harm our forests and ecosystems. Controlling fires in accordance with Nature's scheme must be based on fuel management.

There is no general prescription or formula for controlling fuels. Forested sites differ, and objectives range from essentially unmanaged wilderness to intensively managed recreation areas. However, in areas where the management objective requires maintaining or reproducing forest or other natural communities, Nature's method—**fire**—is a valuable and effective fuel management tool.

Fire's natural role in reducing fuels is partly replaced in timber-producing areas by the harvest and removal of wood products. However, slash, resulting from these activities, creates another fuel problem. Better use of harvested wood is one answer—fire is another. Controlled burning of nonuseable slash further reduces the fuel load and provides nutrients for the plants and animals that inhabit the area.

The technical and scientific refinement of ways to use fire as a management tool has been a major subject of forest research. Scientists are focusing on forest fuel chemistry, fire behavior, meteorology, and other fields to best determine when, where, and how excess fuels are to be burned.



Only in the last century has fire in the forest been viewed as a monster. We are now beginning to realize that fire is a natural agent essential for maintaining the natural ecosystems of Florida. Fire is neither all good nor all bad. It is natural. It is powerful. In the proper places, in the right hands, at the right times, fire can be an asset and an ally. To employ fire as a useful friend is much more logical than confronting it as an enemy.

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